CLAIMS

1. A magnetic resonance imaging apparatus comprising: a super-conducting magnet including a super-conducting coil circuit having a super-conducting coil and a permanent current switch for controlling a permanent current flowing through the super-conducting coil and a heater element for controlling demagnetization of the super-conducting coil or a sensor element for measuring amount of liquid helium which are accommodated in a helium vessel, a control circuit or a monitor circuit which is electrically connected to the heater element and the sensor element and disposed at the outside of the helium vessel, a gradient magnetic field generating means for generating a gradient magnetic field and providing the same to a static magnetic field generated by the super-conducting magnet and a high frequency magnetic field generating means for generating a high frequency magnetic field to be applied to a subject characterized, in that the magnetic resonance imaging apparatus further comprises means for interrupting formation of a closed loop circuit across the control circuit or the monitor circuit and the super-conducting coil circuit.

2. A magnetic resonance imaging apparatus according to claim 1 characterized, in that the interrupting means is a filter circuit unit connected between the heater element and the sensor element and

the control circuit or the monitor circuit.

3. A magnetic resonance imaging apparatus according to claim 2 characterized, in that the filter circuit unit includes an outer casing and a filter element accommodated in the outer casing and a conductor connected to the outer casing forms another closed loop circuit, which bypasses the aforesaid closed loop circuit, together with the control circuit or the monitor circuit through the helium vessel.

4. A magnetic resonance imaging apparatus according to claim 1 characterized, in that the interrupting means is a switch circuit connected between the heater element and the sensor element and the control circuit or the monitor circuit.

5. A magnetic resonance imaging apparatus according to claim 2 characterized, in that the filter element in the filter circuit unit at least cuts off signals having driving frequencies of the gradient magnetic field generating means and frequency band of the high frequency magnetic field.

6. A magnetic resonance imaging apparatus according to claim 1 characterized, in that the super-conducting magnet is constituted by a pair of super-conducting coils which are disposed so as to sandwich the measurement space where the subject is laid.

7. A magnetic resonance imaging apparatus

according to claim 6 characterized, in that the gradient magnetic field generating means and the high frequency magnetic field generating means are respectively constituted by flat plate shaped coils which are respectively disposed so as to sandwich the measurement space where the subject is laid.

8. A super-conducting magnet device comprising a super-conducting coil circuit having a super-conducting coil and a permanent current switch for controlling a permanent current flowing through the super-conducting coil and a vessel accommodating the super-conducting coil at a temperature for maintaining the same in super-conducting state characterized, in that the super-conducting magnet device further comprises means for electro-magnetically shielding the super-conducting coil from the outside of the vessel.

9. A super-conducting magnet device comprising a super-conducting coil circuit having a super-conducting coil and a permanent current switch for controlling a permanent current flowing through the super-conducting coil and a vessel accommodating the super-conducting coil at a temperature for maintaining the same in super-conducting state characterized, in that the vessel is provided with a terminal portion for connecting a heater element or a sensor element disposed in the vessel to an external circuit and the terminal portion is provided with means for forming a closed loop

circuit including the external circuit, an outer wall of the vessel and a grounding point provided at the wall.

10. An open type magnetic resonance imaging apparatus using a super-conducting magnet comprising a super-conducting magnet including a pair of grounded cryostats which are disposed facing in vertical direction so as to sandwich a measurement space where a subject is laid, helium vessels each being accommodated in the respective cryostats and being filled with liquid helium, a super-conducting coil circuit constituted by super-conducting coils each being disposed in the respective helium vessels and a permanent current switch which is disposed in one of the helium vessel and controls conduction of permanent current to be flown through the super-conducting coils and an element for controlling demagnetization of the respective super-conducting coils and another element for measuring amount of the liquid helium filled, a control circuit and a monitor circuit which are disposed outside the cryostats and are respectively connected electrically to the control element and the measurement element, flat plate shaped gradient magnetic field coils which are respectively disposed at facing surface sides of the respective cryostats and generate gradient magnetic field provided for static magnetic field generated by the super-conducting magnet and flat plate shaped high frequency magnetic field coils which are

respectively likely disposed at facing surface sides of the respective cryostats and generate high frequency magnetic field to be applied to the subject characterized, in that the open type magnetic resonance imaging apparatus using a super-conducting magnet further comprises means for preventing high frequency current induced by the gradient magnetic field coils or the high frequency magnetic field coils from flowing in from the control circuit or the monitor circuit to the super-conducting coil circuit.

11. An open type magnetic resonance imaging apparatus using a super-conducting magnet according to claim 10 characterized, in that the means for preventing flowing in of the high frequency current is an electrical circuit for preventing electro-magnetic coupling between the super-conducting coil circuit and the control circuit or the monitor circuit.

12. An open type magnetic resonance imaging apparatus using a super-conducting magnet according to claim 10 characterized, in that the means for preventing flowing in of the high frequency current is a filter circuit for cutting off high frequencies which is provided between the control element or the measurement element and the control circuit or the monitor circuit at the outside of the cryostats.

13. An open type magnetic resonance imaging apparatus using a super-conducting magnet according to

claim 10 characterized, in that the means for preventing flowing in of the high frequency current is a normally open switch which is provided between the control element or the measurement element and the control circuit or the monitor circuit at the outside of the cryostats.

14. An open type magnetic resonance imaging apparatus using a super-conducting magnet according to claim 10 characterized, in that the means for preventing flowing in of the high frequency current bypasses the induced high frequency current through an outer wall of the grounded cryostats.

15. A magnetic resonance imaging apparatus comprising:

a super-conducting magnet including a super-conducting coil circuit having a super-conducting coil and a permanent current switch for controlling permanent current flowing through the super-conducting coil and a helium vessel for accommodating therein the super-conducting coil circuit and at least one electrical element;

at least one electrical circuit which is electrically connected to the electrical element and disposed at the outside of the super-conducting magnet;

a gradient magnetic field generating means for generating gradient magnetic field to be superposed over static magnetic field generated by the

super-conducting magnet; and

a high frequency magnetic field generating means for generating high frequency magnetic field to be applied to a subject, characterized, in that the magnetic resonance imaging apparatus further comprises mean for interrupting noise current generated based on tomographic image measurement of the subject and of which means is disposed outside the super-conducting magnet while being inserted between the electrical circuit and the electrical element.

16. A magnetic resonance imaging apparatus according to claim 15, characterized in that the noise current interrupting means is disposed on an outer wall surface of the super-conducting magnet at a portion where a connecting cable connecting the electrical circuit and the electrical element passes through.

17. A magnetic resonance imaging apparatus according to claim 15, characterized in that the noise current interrupting means is a filter circuit unit connected between the electrical circuit and the electrical element.

18. A magnetic resonance imaging apparatus according to claim 17, characterized in that the filter circuit unit includes an outer casing and a filter element accommodated in the outer casing and with a conductor connected to the outer casing, the electrical circuit and the helium vessel an electrically closed

loop circuit is formed which bypasses the super-conducting coil circuit.

19. A magnetic resonance imaging apparatus according to claim 18, characterized in that the filter element passes electrical signals generated by the electrical element and interrupts noises at least of driving frequencies of the gradient magnetic field generating means and of a frequency band of the high frequency magnetic field.

20. A magnetic resonance imaging apparatus according to claim 19, characterized in that the filter element is a current through type filter of π type filter in which an inductor element is surrounded by the outer casing of a metal cylinder and a through type capacitor is constituted by input and output terminals thereof.

21. A magnetic resonance imaging apparatus according to claim 15, characterized in that the noise current interrupting means is a switch circuit connected between the electrical element and the electrical circuit.

22. A magnetic resonance imaging apparatus according to claim 21, characterized in that the switch circuit is normally in off state in which all of the electrical connection between the electrical element and the electrical circuit is cut off at the same time and, when desired, is rendered in on state in which the

electrical element and the electrical circuit is electrically connected.

23. A magnetic resonance imaging apparatus according to claim 22, characterized in that the switch circuit is rendered in on state at the time when the super-conducting coil is excited and demagnetized.

24. A magnetic resonance imaging apparatus according to claim 15, characterized in that the electrical element is a heater element for controlling the permanent current switch and the electrical circuit is a control circuit for controlling the heater element.

25. A magnetic resonance imaging apparatus according to claim 15, characterized in that the electrical element is a sensor element for measuring amount of liquid helium and the electrical circuit is a monitor circuit for monitoring electrical signals from the sensor element.

26. A magnetic resonance imaging apparatus according to claim 15, characterized in that the noise current interrupting means interrupts formation of an electrically closed loop between the electrical circuit and the super-conducting coil circuit.

27. A magnetic resonance imaging apparatus according to claim 26, characterized in that the noise current interrupting means interrupts formation of an electrically closed loop between the electrical circuit and the super-conducting coil circuit at least at

driving frequencies of the gradient magnetic field generating means and at high frequency band of the high frequency magnetic field.

28. A magnetic resonance imaging apparatus according to claim 27, characterized in that the electrically closed loop is formed via a grounded point of the super-conducting magnet and a grounded point of the electrical circuit.

29. A magnetic resonance imaging apparatus according to claim 15, characterized in that the super-conducting coil of the super-conducting magnet is a pair of coils disposed in a facing manner while sandwiching a measurement space where the subject is laid.

30. A magnetic resonance imaging apparatus according to claim 29, characterized in that the gradient magnetic field generating means and the high frequency magnetic field generating means are respectively flat plate shaped coils each of which are respectively disposed at the sides of the measurement space of the super-conducting magnet in a facing manner while sandwiching the measurement space.

31. A magnetic resonance imaging apparatus according to claim 15, characterized in that the super-conducting magnet includes a pair of grounded cryostats which are disposed in vertical direction in a facing manner while sandwiching a measurement space

where the subject is laid and are connected each other by a coupling tube,

each of the cryostats accommodates therein a helium vessel filled with liquid helium and each of the helium vessels accommodates therein the super-conducting coil circuit, an element of controlling excitation and demagnetization of the respective super-conducting coils and another element for measuring amount of liquid helium filled,

at the outside of the super-conducting magnet, a control circuit and a monitor circuit electrically connected respectively to the control element and the measurement element,

the gradient magnetic field generating means is gradient magnetic field coils having a flat plate shape which are respectively disposed at the facing sides of the cryostats,

the high frequency magnetic field generating means is high frequency magnetic field coils having a flat plate shape which are respectively disposed at the facing sides of the cryostats, and

an induction current preventing means for preventing induction current induced by the gradient magnetic field coils or the high frequency magnetic field coils from flowing between the control circuit or the monitor circuit and the super-conducting coil circuit is disposed on an outside portion of the

cryostats.

32. A magnetic resonance imaging apparatus according to claim 31 characterized, in that the induction current preventing means is an electrical circuit for preventing electro-magnetic coupling between the super-conducting coil circuit and the control circuit or the monitor circuit.

33. A magnetic resonance imaging apparatus according to claim 31, characterized in that the induction current preventing means is a filter circuit which is disposed on an outer wall of the cryostats and is inserted in an electrical connection between the control element or the measurement element and the control circuit or the monitor circuit, and the filter circuit passes electrical signals generated from the control element or the measurement element and interrupts noises at least of driving frequencies of the flat plate shaped gradient magnetic field coils and of frequency band of the high frequency magnetic field.

34. A magnetic resonance imaging apparatus according to claim 31, characterized in that the induction current preventing means is a switch circuit which is disposed on an outer wall of the cryostats and is inserted in an electrical connection between the control element or the measurement element and the control circuit or the monitor circuit, and the switch circuit is normally in off state in which all of the

electrical connection between the electrical element and the electrical circuit is cut off at the same time and, when desired, is rendered in on state in which the electrical element and the electrical circuit is electrically connected.

35. A magnetic resonance imaging apparatus according to claim 31, characterized in that the induction current preventing means returns the induction current induced to the control circuit or the monitor circuit via the outer wall of the grounded cryostats.